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THE

PARKES MUSEUM
LECTURES.

MODERN HOSPITAL CONSTRUCTION.

BY E. C. ROBINS, F.S.A.

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Modern Hospital Construction.

IN response to the invitation of the Council of the Parkes Museum I am to address you to-night upon Hospital Planning, a subject embracing nearly every purpose for which this Memorial Hygienic Museum has been instituted.

Whatever sanitary principles and appliances are needed to make an ordinary dwelling-house sweet and wholesome, within which *healthy* people may live, breathe, and have the full enjoyment of their being, must necessarily be of paramount importance in the case of those who are *sick*. And, still more, the congregation of many disabled and diseased persons under one roof obviously calls for very complete and careful arrangements and special contrivances for the preservation of the purity of the earth, air, and water, both within and around the buildings thus exclusively devoted to the reception of the sick and the healing arts.

It may not be without advantage, therefore, to occasionally pass in review the progress made and still making in the design and construction of hospitals generally,—military, civil, and pauper,—and the improved application of sanitary principles in their construction and maintenance.

Dr. Mouat (our chairman) has divided such buildings into five groups, "the successful treatment of disease being the cardinal condition, or *raison d'être,* of every such institution," thus:—

1. Clinical hospitals, or hospitals attached to or forming part of medical schools, as University and King's College Hospitals.

2. General hospitals, or those in which all classes of cases, medical and surgical, are treated, with or without detached wards for infectious diseases and parturition. In this group Dr. Mouat places the great separate Workhouse Infirmaries.

3. Special hospitals, such as fever and small-pox hospitals, lying-in hospitals, ophthalmic, skin, orthopædic, and other institutions, devoted to specific purposes, as indicated by their names.

4. Cottage hospitals.

5. Convalescent hospitals, the "missing link" between the hospital and the home.

Dispensaries, free and provident, and all institutions which have no beds for taking in-patients, are excluded from the foregoing list.

In a mixed audience it will be undesirable to be either too technical or too detailed in the treatment of the subject in hand; but with the assistance of the numerous drawings with which I have sought to illustrate the paper, it will be possible to obtain a pretty clear idea of where we are, and what should be aimed at, in our studies, yet further to develope the science of hospital hygiene. In all such efforts, it is always essential to success that the public should be sufficiently well informed to be able to recognise and encourage the promoters and originators of every improvement as it appears.

The fitness of means available, to ends attainable, is the best use to which technical education can be turned. And I know of no better training for a young architect, who would be useful as well as ornamental, than the study of the various English and foreign works in hospital construction, sanitation, and general arrangement, especially if he follow it up by making original designs based on the information so obtained, confirmed or otherwise by personal inspection, observation, and comparison of existing examples. Such designs are all the more likely to be practically valuable if they are made in answer to invitations to architects to compete for the erection of some public building of the kind.

It was in this way that I acquired what little I know of the subject of which I am now treating; and the room is surrounded with a series of early designs prepared by me in competition for the various hospitals whose titles appear in the drawings exhibited. Some of these are premiated designs; some are neither premiated nor executed; and some are both.

It is not, however, by my own designs that I propose to illustrate this paper,—I exhibit them as studies, not models,—but rather by the process of comparative analysis afforded by the representation of a series of typical examples of existing buildings, drawn to one scale, and placed side by side.

Bnt a few prefatory remarks are needed as an introduction to their consideration, for it was not till the death-rate in hospitals as formerly built had increased to an alarming extent that the public conscience was awakened, and its responsive echoes were heard in the House of Commons.

The lessons learned in the Crimean war will go far to redeem its losses. It is now nearly a quarter of a century since the report of the Barrack and Hospital Improvement Committee and the report of the Commissioners on the Sanitary Condition of the Army appeared, and by its authoritative recommendations, based upon world-wide and most voluminous evidence, firmly established what is commonly known as the "Pavilion system" of hospital planning, the simplest form of which principle was exemplified in the Hounslow Hospital, with the pavilions in line having a central administrative department and single-story wings for wards for the sick in the same axis as the main building. The Bucks Infirmary is a good example of a civil hospital on this plan, of two stories, and there are many other examples exhibited.

The more extensive and complex form of the same principle found its happiest embodiment in the great Herbert Hospital at Woolwich, a full and complete description of which was presented to both Houses of Parliament in 1865 in the form of a report by its chief designer, Captain Douglas Galton, who was assisted by the leading authorities of the time.

In this admirable essay little of novelty is left to be said upon the general subject, and the building it describes still continues to be, though one of the earliest, yet one of the best of the great modern hospitals.

The valuable series of papers by Mr. George Godwin, F.R.S., the editor of the *Builder*, did much at that early time to popularise the new principles, which consisted in the entire separation of the sick wards in distinct buildings or pavilions, united only by a covered or closed corridor on the ground story with the administrative departments of the hospital.*

The conclusions to which the Royal Commissioners arrived under the presidency of the late Lord Herbert were summarised as follows, and laid down as the principles to be observed in the construction of all military hospitals:—

1. The cubic space per bed to be 1,200 ft. at home, and 1,500 ft. in tropical climates.

2. In the construction of new hospitals the adoption of separate pavilions with lateral windows in opposite sides and natural ventilation.

3. The use of Parian cement or other impervious material for walls and ceilings.

4. Sufficient provision for warming and lighting the hospital.

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* We may be pardoned for stating in the interests of truth that these endeavours, obligingly referred to, in conjunction with the works of the late Mr. Robertson, of Manchester, and Miss Nightingale, preceded the erection of the buildings above named, as well as others, and which in some cases were avowedly founded on the publications in question. Our own reward was the rapid spread of the principles then enunciated, and the concurrent advantages resulting to the human race.

5. The introduction of water-closets and sinks with efficient sewerage by impervious drains free of the buildings; the closets and sinks to be cut off from the hospital by a ventilated lobby.

6. The provision of suitable lavatories, baths, and laundries.

7. The use of stone or fireproof material for staircases and landings instead of wood.

8. The introduction of cooking apparatus.

The Barrack and Hospital Committee appointed in 1857, by Lord Panmure, on the recommendation of the Royal Commissioners adopted these principles as the basis of its proceedings, and set about their practical application, which afterwards bore good fruit, as we have seen in the foundation of the Herbert Hospital.

The first thing that claimed the attention of the committee was the form of the sick wards, and the minimum and maximum number they should contain, for most wisely they considered that the accommodation required for the inmates should be made to govern the shape of the hospital, all other portions being made subsidiary.

The best form of wards in military hospitals, in the opinion of the committee, was thus defined:—

1. The wards for the sick to be 24 ft. in width, at least, to ensure the requisite facilities for ward work.

2. The wall space for each bed to be not less than 7 ft. 2 in.

3. The height of each ward to be 14 ft.

4. The superficial area per bed to be 87 ft.

5. These dimensions give a cubic content per bed of 1,218 ft., which is very nearly that recommended by the Royal Commissioners for home stations; but the committee wisely added that the maintenance of the superficial area per bed was of more importance than mere cubic space. The maximum number of beds to a ward was fixed at thirty-two, and preference was given to the plan of placing the beds between the lateral and opposite windows, instead of

next blank walls, with end windows, which would reduce the accommodation more than one-half to obtain an equally cheerful and well-lighted ward. The number of beds to be placed between the windows was limited to two.

Great simplicity in the heating and ventilating processes was recommended, and the separate warming and ventilating of the lavatories and water-closets was adopted in addition to the cross-ventilation by windows of the entrance lobbies to the conveniences,—the use of which latter in winter was impracticable, and consequently the ventilation of these conveniences had previously commonly been into instead of away from the sick wards, the higher temperature of the latter sucking in the foul air of the former.

Open-fire ventilating-stoves were recommended for heating the wards, but it is doubtful if the ordinary radiating-stoves will always be found sufficient in long wards of the size recommended, with so large a surface of cold radiation from the windows and walls, though well enough for smaller wards.

The indirect manner in which a room is warmed by radiation, the open fire heating the walls and furniture, and through them reflecting it back into the room, creates a limitation in their fitness for this purpose, the opposite end walls of the wards being too distant to get warm or reflect much heat. It is, therefore, desirable to supplement the open fire by hot-water piping during the winter months, over which the fresh air admitted may pass, and be sufficiently raised in temperature without losing its freshness.

It is only fitting in this place that I should put you in possession of Dr. Parkes's opinions on this subject, briefly stated by him in the second edition of the ninth chapter of his now famous work of 800 pages, entitled "Practical Hygiene," which has gone through five editions, the last being edited by his successor and sometime associate, Dr. F. de Chaumont, Professor of Military Hygiene in the Army Medical School at Netley. In his opening remarks, Dr. Parkes pays a high tribute to Miss Nightingale's work entitled "Notes on Hospitals," which gave an impetus to the study of the subject, and led to the publication of many works on hospital construction and management in England, France, Germany, and America, which, taken in connexion with Mr. Godwin's professional papers, formed my chief text-book when preparing the designs exhibited.

Dr. Parkes sounds a note of warning as to the dangers necessarily arising from the aggregation of many sick people under one roof, and he draws attention to the risks of contamination of the air and of impregnation of the materials of the building with morbid substances being so much increased thereby that the greatest care is necessary that hospitals shall not become pest-houses, and do more harm than good; but he also assures his readers that a great supply of air, by immediately diluting and rapidly carrying away the morbid substances evolved in such quantities from the bodies and excretions of the sick, reduces the risk to a minimum, and perhaps removes it altogether. The quantity of air required for this purpose is very large, which he estimates at an average of 4,000 cubic feet per head per hour.

As an important means to the end desired, Dr. Parkes gives his adhesion to the pavilion form of building for large hospitals, the detached sick wards being wide apart, so that 1,000 sick should spread like a village. From 100 ft. to 120 ft. superficial should be given to each bed, in his opinion, and from 1,500 ft. to 2,000 ft. of cubic space. He prefers natural to artificial ventilation dependent on the movement of the outer air, and on the inequalities of weight, and consequent pressure, of the external and internal air. Upon this point there is a variety of opinion, and doctors differ very much. He limits the width of the wards to 24 ft., with opposite lateral windows reaching nearly to the ceiling, and considers that there should not only be good ventilation, but that the wards, in turn, should be empty for two or three weeks in every year. The fewer the number of stories the better, single stories being the best arrangement. The ward walls to be lined with impermeable materials, and the floors of hard wax-polished wood, the furniture being reduced to a minimum.

Dr. Parkes gives an illustration of the arrangement of the lavatories, water-closets, baths, &c., at the end of a 26-ft. wide ward,—extracted from Miss Nightingale's book, which he approves,—showing the cross ventilated passages to the same, on either side of the large window at the extreme end of the ward. A stove is provided for warming each passage,—to the slop-sink and water-closet on one side, and to the bath, urinal, and lavatory on the other.

The patients in a ward may be any even number between twenty and thirty-two, and separate small wards for one or two beds should be provided; also a ward-scullery and nurses' room, with window overlooking the wards.

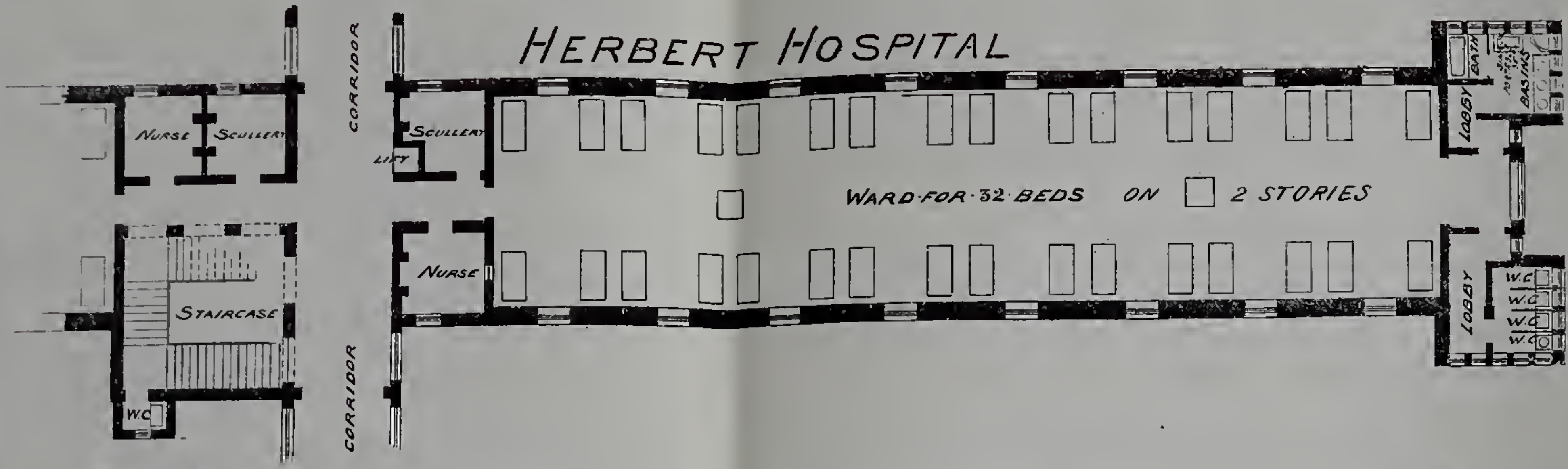
Where space and means are sufficient, day-rooms are most desirable, but more especially an external ambulatory.

Dr. Parkes proceeds to say that with regard to the supply of food, the diet of the sick is now becoming a matter of scientific precision, and he adds that the kitchen should be centrally placed, but quite apart from the sick-wards, and means should be taken to keep food warm in hot closets near the wards.

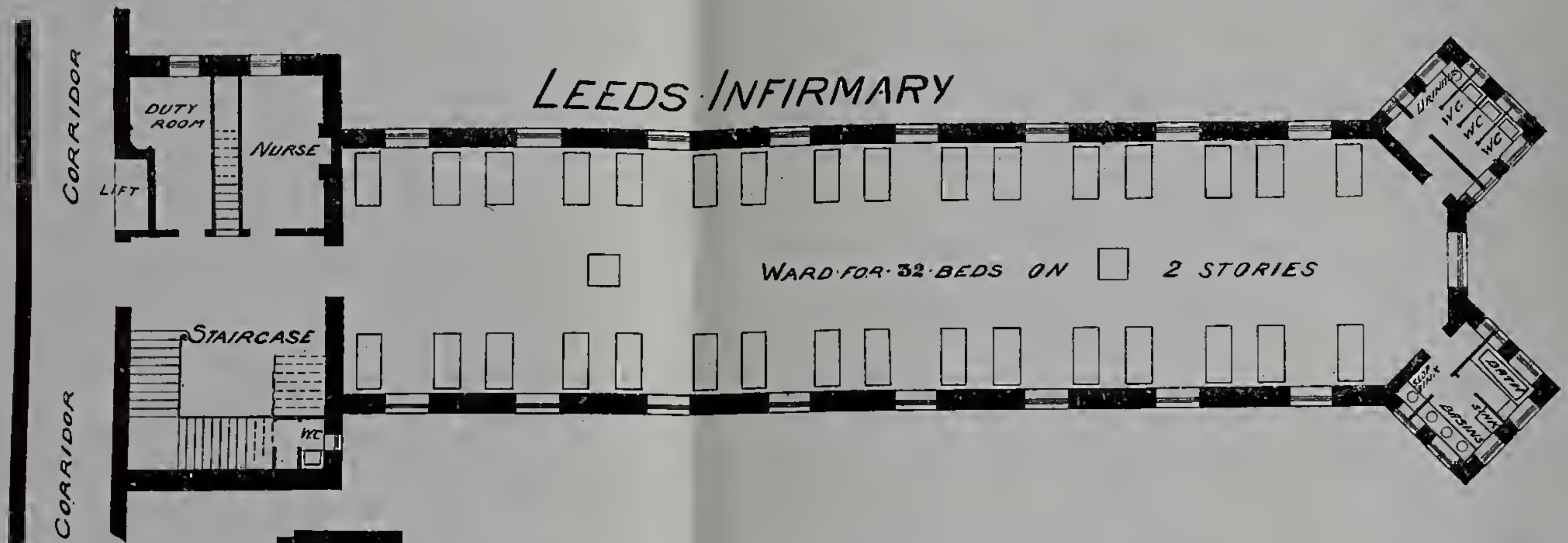
Hot and cold water to be supplied everywhere, and the supply to be from 40 to 50 gallons per head daily. Every contrivance to save labour and cleaning should be employed,—lifts, tramways, and speaking-tubes,—to save time and enable the attendants to give their full attention to their patients.

Dr. Parkes gives but two illustrations,—the Lariboisière Hospital of Paris, and the Herbert Hospital of Woolwich,—which latter he considered "the best military hospital in the country, or perhaps any where." By comparing the illustrations I have given, an obvious defect

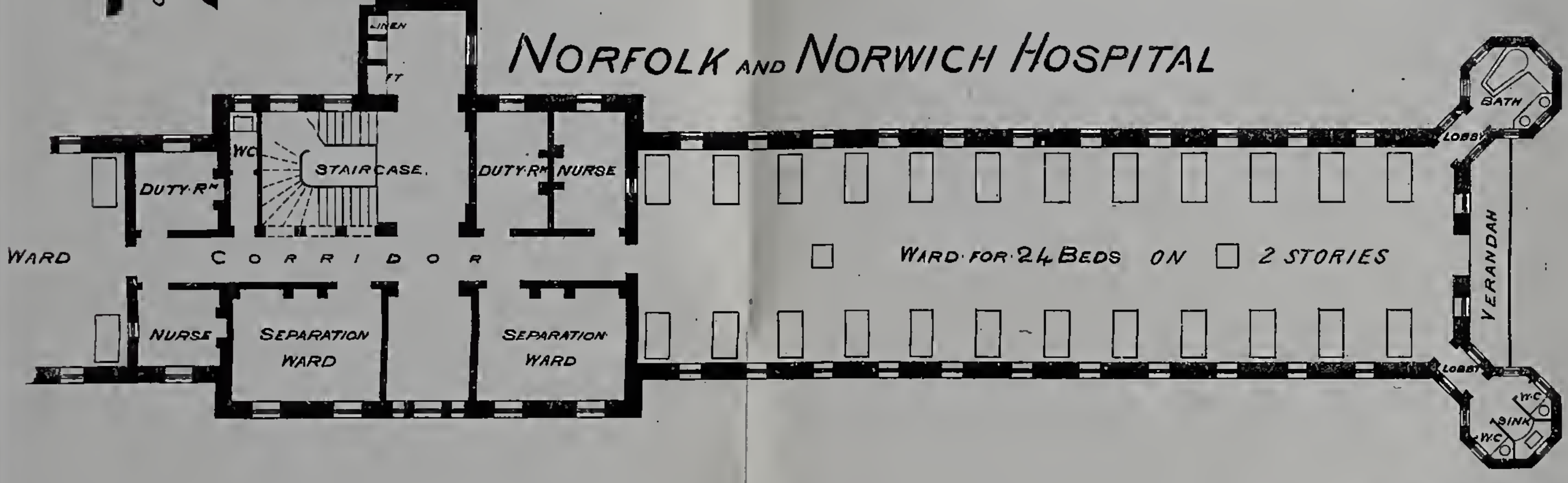
HERBERT HOSPITAL



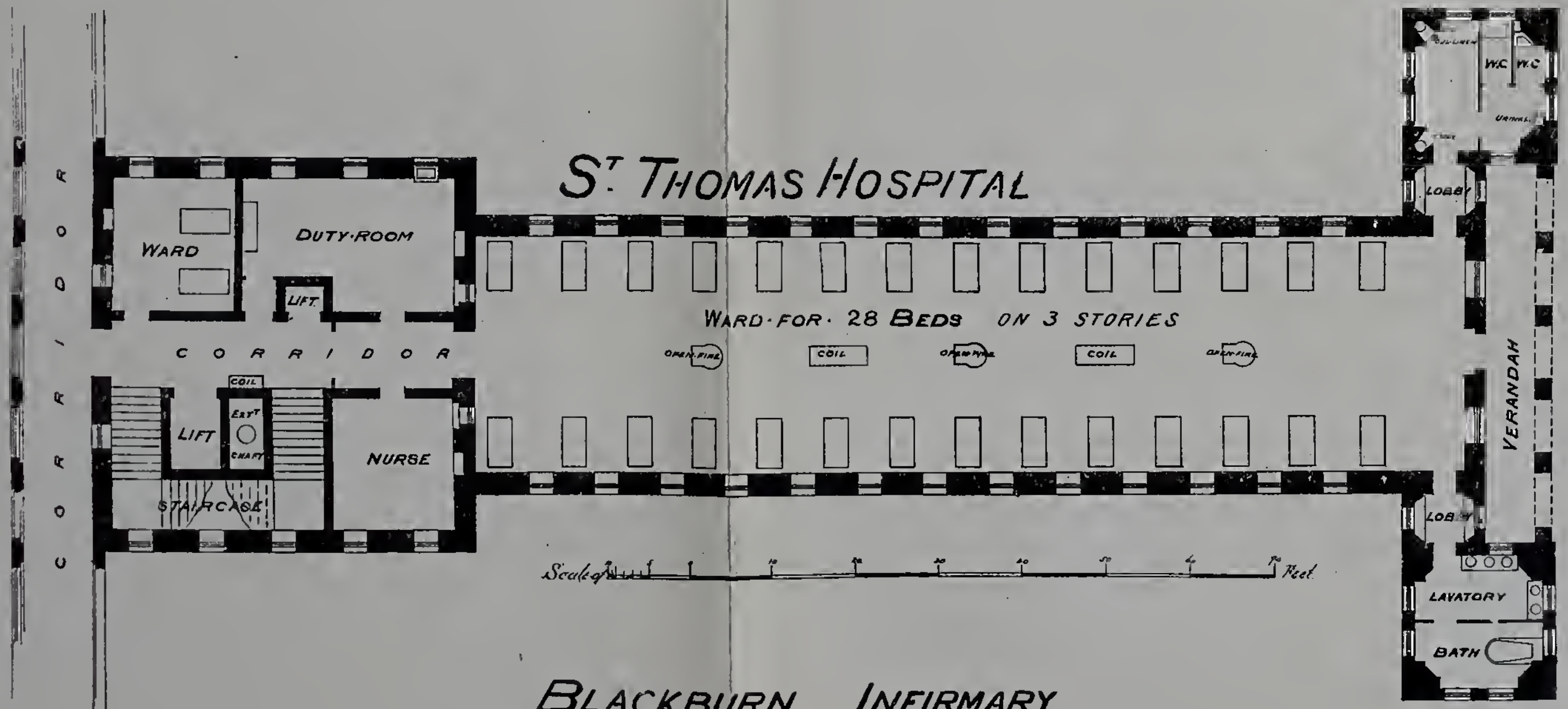
LEEDS INFIRMARY



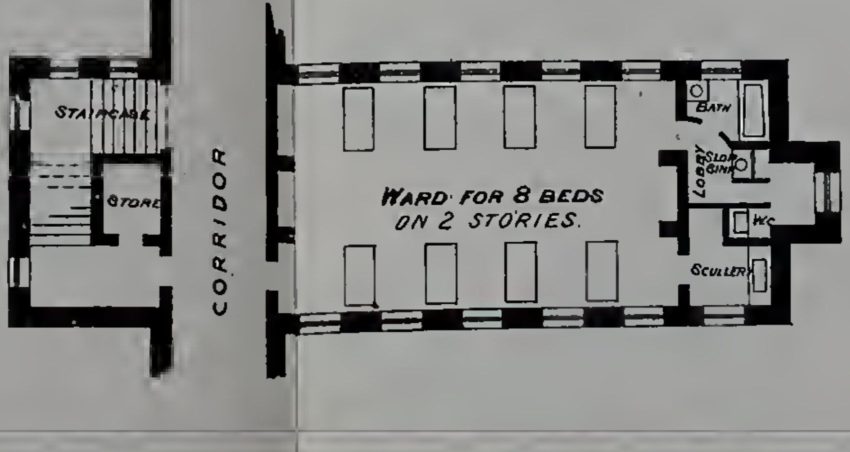
NORFOLK AND NORWICH HOSPITAL



ST THOMAS HOSPITAL



BLACKBURN INFIRMARY



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will be noticed in the former building, namely, the enclosed central court, from the sides of which the pavilions project, while free and uninterrupted openness to every wind is the distinguishing characteristic of the latter.

The Lariboisière has not proved a healthy hospital, but the Herbert Hospital is eminently so, especially since more warmth has been given in winter.

The Herbert Hospital consists of four double and three single pavilions, of two floors each, all raised on basements, and connected by a 12 ft. wide corridor. There is a convalescents' day-room in the centre pavilion. The administration is in a separate block in front. The axis of the wards is a little to the east of north. There is a corridor in the basement, through which the food, medicines, coals, &c., are conveyed, and then by a series of lifts elevated to the wards.

The terraces on the corridor afford easy means of open-air exercise for the patients in the upper ward. The wards are warmed by two central open fireplaces with descending flues, round which are air-passages, so that the entering air is warmed. The lavatories and water-closets are separately warmed and ventilated. The floors are supported on iron joists, filled in with concrete, and covered with oak floor-boards.

There are 650 sick inmates in this hospital,—twenty more than are accommodated in the Lariboisière. The large wards, for 32 beds each, measure 117 ft. by 26 ft. by 13 ft. 6 in. high. The superficial floor area is 97 ft., and the cubical contents, 1,315 ft. per bed.

Professor de Chaumont, Dr. Parkes's successor in office, in his report on the Norfolk and Norwich Hospital, says that the height of wards is to him an important question; for that nothing is gained by making them more than half their width, or 12 ft. high, the width of the wards being 24 ft., and the superficial space, 100 ft. He had proved by experiments upon which tables had been constructed, that there is practically no difference in favour of 1,400 cubic feet per bed and 1,200, the floor-space being equal, the conditions of the air being relatively identical at the end of the second hour. Taking into account, therefore, the increased difficulty of warming the larger space, and the greater cost of construction, there would seem to be small advantage gained by passing a certain limit of height, to say nothing of the disadvantages referred to, and the increased cost.

Then, again, as to limits of practical ventilation. Professor de Chaumont says we can hardly hope to change the air oftener than three times in the hour without draught, and as 4,000 cubic feet. is the minimum that ought to be given per head per hour, the third of this, or 1,333 cubic feet, ought, therefore, to be provided as air-space per bed. With 108 ft. of floor-space, 12 ft. 6 in. high would give 1,350 cubic feet per bed, which, if changed three times in the hour, would require 4,050 cubic feet of fresh air per bed per hour, which is generally considered to be sufficient for all practical purposes.

As regards the temperature of the air thus introduced and exchanged as a means of ventilation, the Professor proceeds to say that it ought to be remembered that in cold weather in this country, warming part of the air is necessary, if a sufficient supply is to be brought in for sanitary requirements; and that for this purpose air brought in directly from without, over coils of hot-water pipes, is best for a large ward. In this view I quite accord; and in the Training Hospital at Tottenham, now building, I have adopted this plan as an aid to the open fireplace, which I still retain for the sake of its cheerfulness and companionship, and its aid as a means of expired air extraction by its flue.

The wide divergence of opinion in the many subjects connected with hospital construction and management makes it unwise to be empirical; it is enough to commend what seems the best and to condemn what has been proved the worst, and between the two extremes to be content to give the opinions and the arguments supporting them, without attempting reconciliation. Time and experience can alone judge between them.

As Mr. Snell has observed in his introduction to the second section of the valuable work on modern hospitals, which has just been published by him and Dr. Mouat:—"While most of the now generally-accepted principles of hospital construction are nearly identical in all countries, yet in the practical application of them to matters of detail considerable diversity exists. On the other hand, there are a few important points, such, for example, as the question of aspect, upon which no two authorities appear to be in entire accord, for it would not be a very hazardous conjecture to make, that from amongst all the best pavilion-hospitals now existing, an axis could be found for every two points of the compass. Then, with regard to the even more important question of cubic space requisite for sick wards, we find this varies in general hospitals of admittedly good type from 1,300 ft. to 2,500 ft. per bed, and the floor space from 90 to 150 superficial feet per bed."

The Marylebone Infirmary.

From military we may now pass on to workhouse hospitals, and it will be sufficient to describe the latest, said to be "the most perfect building of its kind yet erected," which was opened by their Royal Highnesses the Prince and Princess of Wales. The architect was Mr. Henry Saxon Snell, whose experience and skill gained from the erection of five other large metropolitan infirmaries has culminated in this, the Marylebone Infirmary at Notting Hill,—full particulars of which will be found in the work from which I have just quoted, and in a previous volume published by Mr. Snell on "Charitable and Parochial Establishments," wherein he has given the results of his large experience and patient perseverance in the endeavour to raise the character and efficiency of these houses of refuge for the London poor.

This great building gives accommodation for 744 inmates, in thirty-six wards of two beds in each, and twenty-four wards of twenty-eight beds each, in distinct pavilions.

The main corridor, connecting together the various blocks of buildings, is 10 ft. wide; it runs through the centre of each double pavilion, and has passages 6 ft. wide leading off from it to the various wards. It is enclosed with rising sashes, and is roofed so as to form an ambulatory for the use of convalescent patients. The main sick wards of this building are similar to those of the Herbert Hospital, being planned as pavilions, in pairs, connected together, in each case, by a staircase, duty and day rooms, and other offices; but each double pavilion, owing to the necessities of the case, contains three floors of wards instead of two, as at Woolwich. The height of the eaves of the roofs of the pavilions is 39 ft. 6 in., and they are situated nearly twice their height apart. Each ward is of parallelogrammic shape, and contains twenty-eight beds, is 84 ft. long, 24 ft. wide, and 13 ft. high. The total floor-space, equally divided, gives 72 ft. per bed, and the cubical contents 936 feet per bed. The average lineal wall space is 6 ft. per bed.

The system of warming is that of open fireplaces, combined with hot-water heating-pipes, on a principle invented by the architect. This apparatus is known as the "Thermhydric grate," and is one of the exhibits in this museum. Its construction is such that the sides, back, and top of the fire are surrounded by a wrought-iron case containing water, and communicating by means of short tubes, with upright coils of pipes, so placed on each side that the water when heated by the fire circulates through them.

The medical officer of St. Olave's Union gives his testimony in favour of these stoves, stating that they gave out from 3° to 5° more heat, and consumed a third less coal, than the previous stoves in use.

"The ventilation of the wards," says Mr.

Snell, "is effected by purely natural means, and is dependent, therefore, upon the very simple and well-known fact that heated air will always rise to a higher point than the colder air surrounding it, and that in its passage it will carry away with it noxious gases and other deleterious matters which would otherwise, by reason of their greater density, remain stationary or descend to the floor-level." The fresh air is brought in under the bed-heads, and is extracted by horizontal channels in the ceiling between each pair of beds communicating with 14 in. and 9 in. vertical ventilating-flues in the walls. The general ventilation of the wards is supplemented by the central stoves and upcast shafts in the side-walls, the total area of the outlet and inlet flues being 15 ft. in each of these sick wards. In the separation-rooms, 1,300 cubic feet of air-space is given to each of the two beds. The cost was only 177*l*. per bed.

In the year 1867 I was engaged by the guardians of the parish of St. Pancras to erect several dispensaries, having successfully competed for the enlargement of the workhouse, which, however, was not then carried out; but I won a premium for my design for the St. Pancras Infirmary in the year 1869, the plans of which are exhibited to-night, consisting of five blocks of wards, three stories in height, with separate administrative block, and all connected by the usual corridor, forming an ambulatory over, as shown in the perspective view.

I now come to the consideration of general hospitals, some of which, both in England and on the Continent, I have personally inspected; and for others I shall be dependent chiefly on the well-attested facts given in Dr. Mouat and Mr. Snell's book, which cannot be too highly praised, and will always remain a useful *aide-mémoire* to the profession, and reference-book for the student, to whom, I must also recommend (in addition to Mr. Godwin's essays and Captain Galton's reports in the Herbert Hospital and the Norfolk and Norwich Hospital, and his papers in the *Lancet* in connexion with Dr. Sutherland) the reports of Messrs. Bristowe and Holmes and the treatise of Dr. Oppert and M. Husson, the latter so highly praised in Miss Nightingale's book.

An admirable *résumé* of the papers in the *Lancet*, entitled "Principles of Hospital Construction," was given during the year 1874 in an architectural contemporary. In 1881 Dr. Monat described in the *Lancet* two remarkable foreign examples, with reference to which I shall have something to say farther on; in the mean time, let us glance at a few of the more important modern examples of the new principles of hospital planning.

The Blackburn and East Lancashire Infirmary

is an example which is usually quoted, but is not one to be imitated in many respects. The accommodation is ultimately intended for 158 beds, in fourteen wards for eight beds, three for six, eight for two, and twelve for one each.

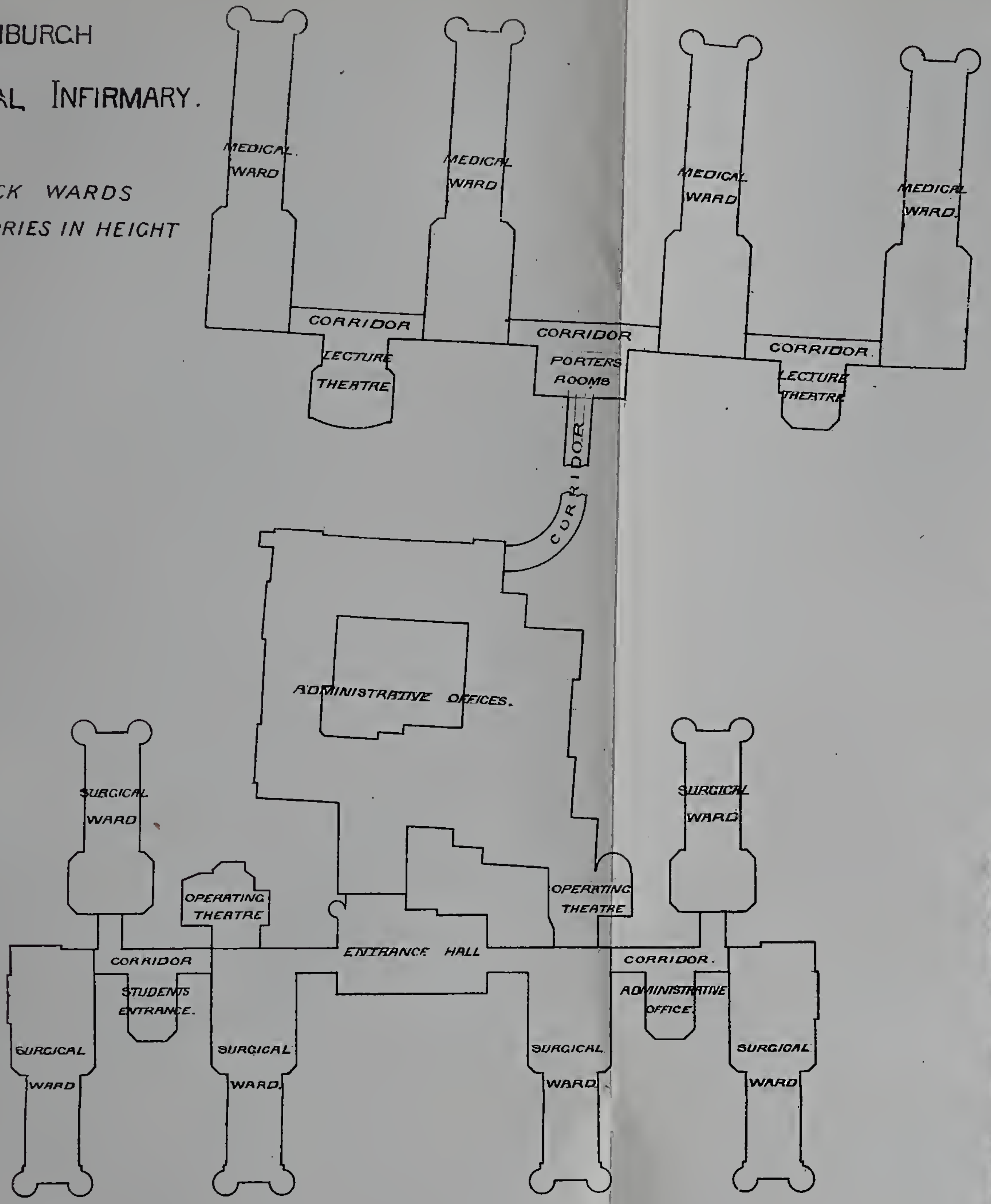
The general plan consists of eight ward blocks besides the central administrative blocks, arranged alternately on each side of the connecting corridor, which is three stories in height, including its basement. The comparatively small wards for eight beds only are 39 ft. by 22 ft. 6 in. wide, and 16 ft. high, having an area per bed of 106 ft., and a cubic space of 1,700 ft., the average lineal wall-space being 9 ft. 9 in. The ward opens directly into the corridor,—the staircases being projected on the opposite side of the same; and the ward scullery, and bath, water - closet, &c., are huddled together at the end of the wards, without any attempt to obtain cross-ventilation, and neither the slop-sink nor the water-closet has any window opening directly to the air.

There are no nurses' rooms, and I instance this example to show that there still remains the necessity for much watchfulness over the manner in which the details are carried out in public buildings; doubtless these effects will be remedied in the wards still unbuilt.

HOSPITAL PLANNING.

EDINBURGH ROYAL INFIRMARY.

SICK WARDS 3 STORIES IN HEIGHT



BLOCK PLAN.

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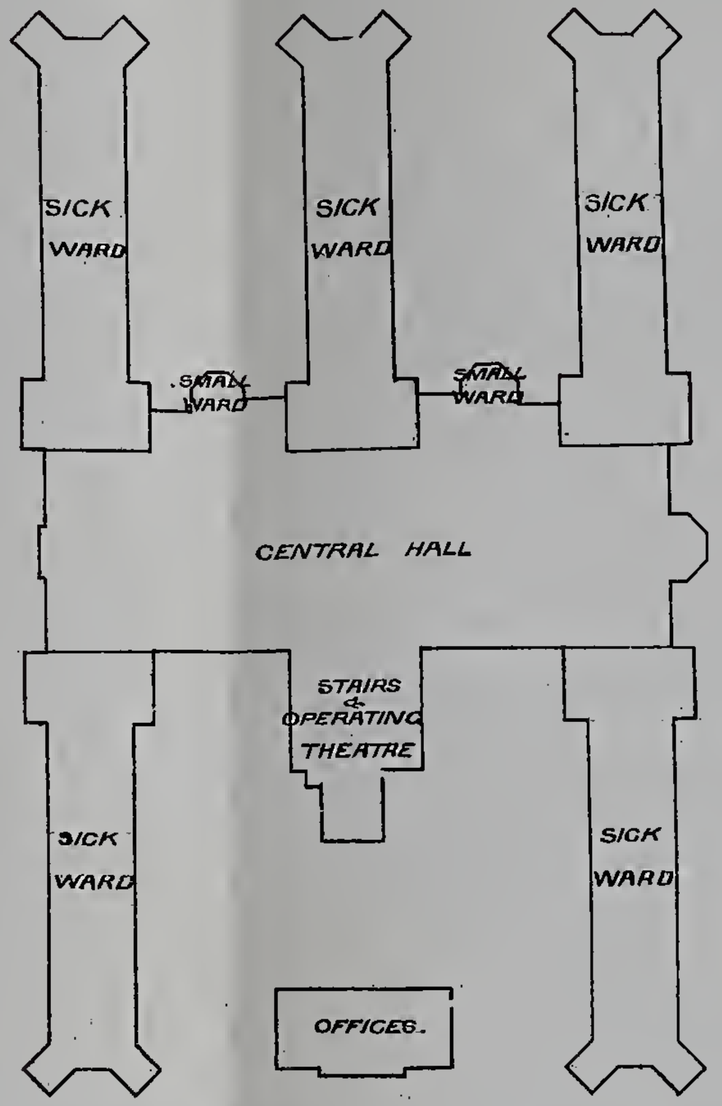
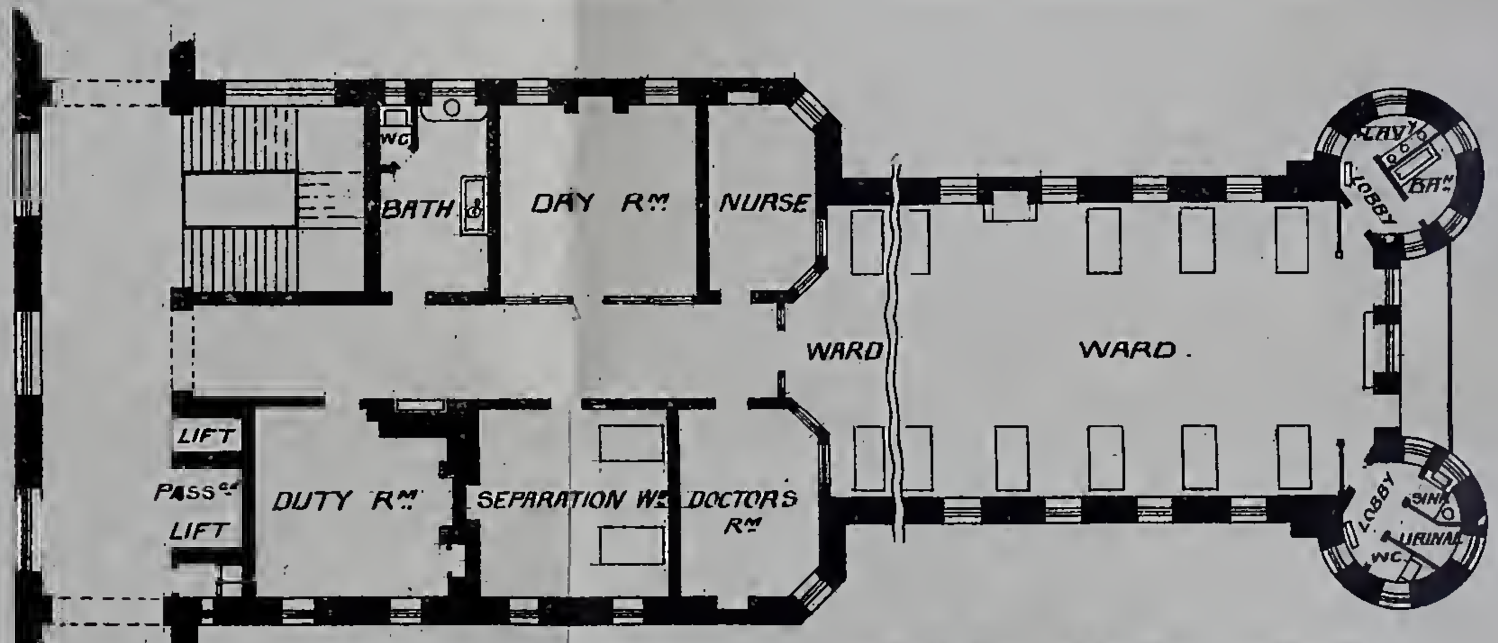
LEEDS GENERAL INFIRMARY.



TWO STORIES OF SICK WARDS THROUGHOUT.



DETAIL OF END OFFICES TO MEDICAL WARDS. EDINBURGH. R.I.

Wyman & Sons, Printers, Gᵗ Queen Sᵗ

The Leeds General Infirmary

is one of the finest provincial hospitals, and was designed by the late Sir Gilbert Scott, for 328 beds. The axis of the wards is north and south; the three northern wards are two stories in height and the two southernward blocks are three stories in height, the building being thus accommodated to the great fall of the ground from north to south. The wards are projected from the northern and southern sides of a central hall, the purpose of which intermediate building is not quite apparent. The low corridor surrounding the central open space without the intervening hall would have been better; but, better still, a single corridor with double ward blocks, as at the Herbert Hospital, would have been an improvement. The lowest floor of the southern ward blocks need not then have formed a part of the administrative offices; ample space would have been attainable between the southern block offices and the ward corridor, or wings might have been added to it. As it is, the kitchen offices are situated beneath the sick-wards, and not only so, but the basement contains the laundry, the dead-house, and the post-mortem room, all which it is always considered very important to keep as distant from the sick-wards as possible. As there was no lack of land in this case it is the more remarkable that this oversight should have occurred.

The wards themselves are admirably planned. The distance between them is 2¼ times their height. The four large ones towards the south contain 32 beds each; the six towards the north contain 28 each. The former are 126 ft. 6 in. in length, the latter 112 ft. All are 27 ft. 6 in. wide; the lower story is 16 ft. 6 in. in height, and the upper 20 ft., which Dr. De Chaumont would consider undesirably large; 107 ft. is the superficial area per bed, and the cubical contents of the lower wards are about 1,760 ft. per bed, while those of the upper wards are 2,136 ft. per bed. The average lineal wall-space per bed is 7 ft. 5 in. The sanitary appliances at the canted ends of the wards are well arranged, but are not separately heated, so that the air within them has a tendency to be drawn towards the warmer atmosphere of the wards. There are no day-rooms, but the nurses' rooms and staircases are situated at the entrance of the wards, and since the separate erection of nurses' quarters, a single-bedded separation ward is thus available to each ward.

The heating of these wards by stoves has been found insufficient, and is being supplemented by steam piping. The inlets for fresh air have mostly been closed, owing to the coldness of the wards, and the outlets more often form inlets than extraction-shafts. In this case it is evident that the architectural has dominated over the practical interests, and therefore this otherwise magnificent building can scarcely be deemed a model one.

St. Thomas's Hospital.

This hospital has but few of the defects of the last described building, except such as have resulted from attempting too much on so confined a site. If it had been one story less in height it would have answered all the purposes, for it is too costly in maintenance to keep full, and arrangements have been made to turn a portion of it to the service of private paying patients. The situation of the kitchens and dining-rooms under the wards, and the nurses' rooms in the attic story, is not happy, but was a necessity in this case. The axis of the six ward-blocks is east and west, and they project towards the river from the low range of buildings next Palace-road. The pavilions are six stories in height, including the basement and the attics. The three uppermost of the four remaining stories are the sick-wards, which are well arranged for twenty-eight beds in each, are connected together by staircases and by corridors on the ground and first floors running the whole length of the building. The wards are 120 ft. long by 29 ft. 4 in. wide, and 15 ft.

high; the superficial space is 126 ft. per bed, and the cubic contents 1,886 ft. per bed. The lineal wall space per bed is 8 ft. These wards are 3 ft. wider than is necessary.

The wards are heated by three stoves, and supplemented by hot-water pipes. Heated shafts withdraw the vitiated air. The ventilation is fairly successful.

The offices are in a separate block, next the bridge. The mortuary, lavatories, and workshops are in a separate building at the opposite extreme end of the site.

The chapel is in the centre of the main building; and overlooking the space between the pavilions are the matron and nurses, the waiting-rooms and operating-theatres, the officers' apartments and the out-patients' department. The total accommodation is for 573 inmates, and the cost, not far short of 1,000*l.* per bed, including land and furniture and the costly foundations, is much too great. Mr. Snell says,—"The total cost of the buildings, exclusive of the site, was at the rate of 777*l.* per bed, of which 85*l.* per bed was spent in the foundations, the total cost being 969*l.* per bed," or five times the cost of the Marylebone Infirmary, yet with 171 fewer beds in the total accommodation. Yet it has cost one and a half times less than the Hôtel Dieu, which cost 2,500*l.* per bed, half of which was spent in acquiring the site. It is a building of palatial character, and highly creditable, nevertheless, to the skill and practical knowledge of the architect, Mr. Currey.

The Glasgow Western Infirmary.

This charming and picturesque building illustrates a retrograde application of the pavilion theory, and except that cross-ventilation is retained by the opposite windows of the wards, is in no sense a pavilion hospital at all.

The administrative department is mixed up with the sick wards, which are not disconnected from the main blocks or from each other by the usual low cross-ventilated corridors.

In the central block and its wings there are two stories of sick-wards over the entrance-hall and board-room, kitchen and scullery, housemaid's pantries, doctors' dining-rooms, and bed and sitting rooms, &c., in the rear of which is the laundry. The other blocks have three stories of sick-wards, the out-patients' department being under one of them.

The accommodation is for 388 sick inmates. Each ward of the double pavilions contains eighteen beds, and is 70 ft. 6 in. long, 26 ft. wide, and 15 ft. high; the superficial area per bed is 108 ft., and the cubic space, 1,620 ft. The average lineal wall space per bed is 7 ft. 10 in.

The sanitary arrangements at the ends of the wards are not properly cross-ventilated by windows, nor are they heated at all, therefore they cannot be commended. But the heating and ventilation of the wards is on a sound principle. The stoves are assisted by hot-water piping, and the fresh air is warmed on its entrance and the foul air is extracted by four 18-inch square gratings communicating by shafts with a space heated by the hot-water cisterns, by which aspiration is accelerated. The products of the combustion of the gas-lights are not, however, carried away separately. The total cost has been 318*l*. per bed.

The Royal Infirmary, Edinburgh.

This splendid building more nearly represents the ideal of a pavilion hospital than any I have yet quoted, always excepting the mother of them all,—the Herbert Hospital,—and does honour to its architect, Mr. David Bryce.

The old buildings were devoted to the administrative department, with a new entrance-hall and offices, on each side of which is the two-story corridor connecting the surgical ward blocks, six in number, and two operating-theatres. In the rear is another single-story corridor, connecting the four medical blocks, and a corridor at right angles therewith, communicating with the administrative block.

Both medical and surgical ward blocks are three stories in height above the basement, which is used for stores only. Separate blocks are provided for the operating-theatres, surgical and medical, the superintendent's and porters' residences, the lecture-theatre, the infectious wards, the pathological department, the workshops, the engine-room, the laundry, the mortuary, &c., all in addition to the administrative block.

The total accommodation is for 586 beds. The medical wards, for twenty-one beds each, are 115 ft. long, 28 ft. wide, and the height 13 ft. 6 in. and 15 ft. The superficial floor-space is excessive, viz., 149 ft., and the cubic contents of the lowest floor is 2,015 ft.; the next, 2,201 ft.; and the top, 2,238 ft. Why the lowest floors, which seem to need the most, should be least in height is not obvious at first, but is desirable, owing to the tendency of the air of upper wards to be contaminated by that of the lower wards, through the lifts, staircases, and general means of communication in the hospital, but all are high enough,—in general they are too lofty. The lineal wall-space per bed is 9 ft.

The increased area per bed is owing to the position of the fireplaces in the side-walls; there are three in these wards, and the fresh air is warmed in its entrance through them. Openings for fresh air are between each bed, and extract-shafts aspirated by the heat of the hot-water cisterns, on which it is not usually well to depend, especially where, as in this case, the insufficiency of the heating by stoves has necessitated steam-pipes being introduced along each side-wall, some of which could be concentrated in a steam-heated shaft or extraction-chamber.

The sanitary offices are both heated and ventilated. The gas-pendants are also ventilating-lights. The floors are of polished pitch-pine, and the walls are covered with a polished parian cement face.

The surgical wards are similar, but for fourteen beds only. Ample arrangements are made for nurses, duty, day, and bed room; also for a doctor's room and separation ward for two beds, besides the staircase at the entrance of the wards, and in this contrasts strongly with the Blackburn and Leeds Infirmaries. The axis of the wards is east and west, so that the windows face north and south. The cost, including land, was 577*l.* per bed.

The Norfolk and Norwich Hospital

is the last of the hospitals of the United Kingdom that I think it necessary to quote particularly. It consists of a central administrative block, with operating-theatre and wards in the rear of it, and two double pavilions, two stories high, on each side, connected by a corridor of one story, 10 ft. wide and 10 ft. 6 in. high, with ambulatory over. Projected on the south-west are the nurses' dining-hall and the chapel. Separate and distinct blocks are devoted to the isolation-wards, out-patients' department, nurses, museum, and sheds and mortuary. The laundry is at the south-eastern extremity of the site. The axis of the wards is south-east and north-west. The total number of patients is 218. Cost, 300*l.* per bed. The wards contain twenty-four beds in each. Their length is 100 ft. by 26 ft. wide, and 14 ft. high. The superficial area is 108 ft. per bed, and the cubical contents, 1,511 ft. per bed. The average lineal wall-space is 7 ft. 10 in. Dr. De Chaumont and Captain Galton both reported on these hospital plans. I have quoted the opinions of the former, and, at the suggestion of the latter, stoves were used for heating, and Mr. Snell's Thermhydric stoves have been employed.

The ventilation is sensible, and like that at St. Thomas's Hospital. The sanitary offices are heated and ventilated by means of hot coils of water-pipes placed in chambers situated in the louvred turrets of the towers. Fresh air is abundantly admitted and extracted, and two ventilating sun-burners assist materially in extracting the foul air. The sanitary offices are

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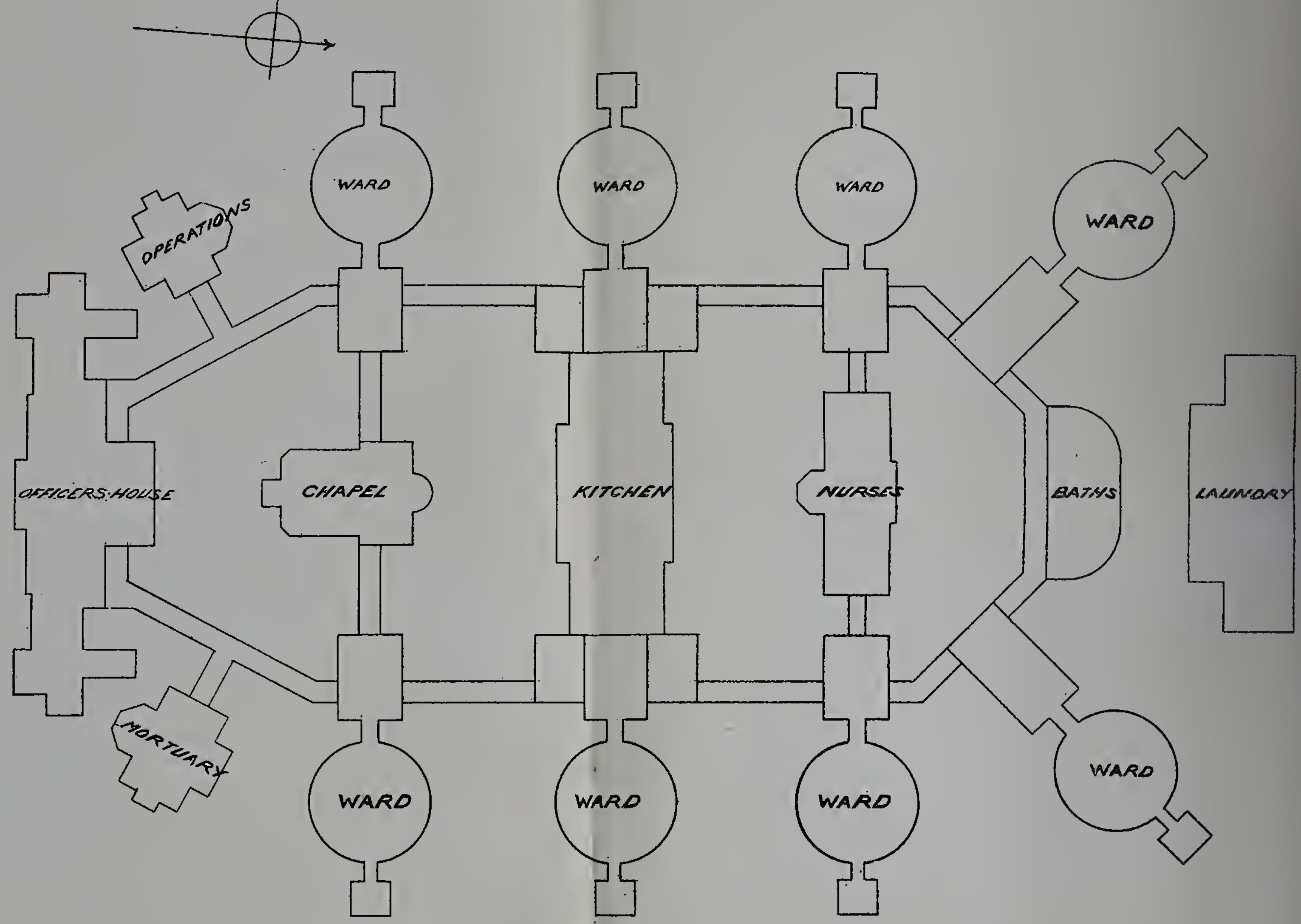
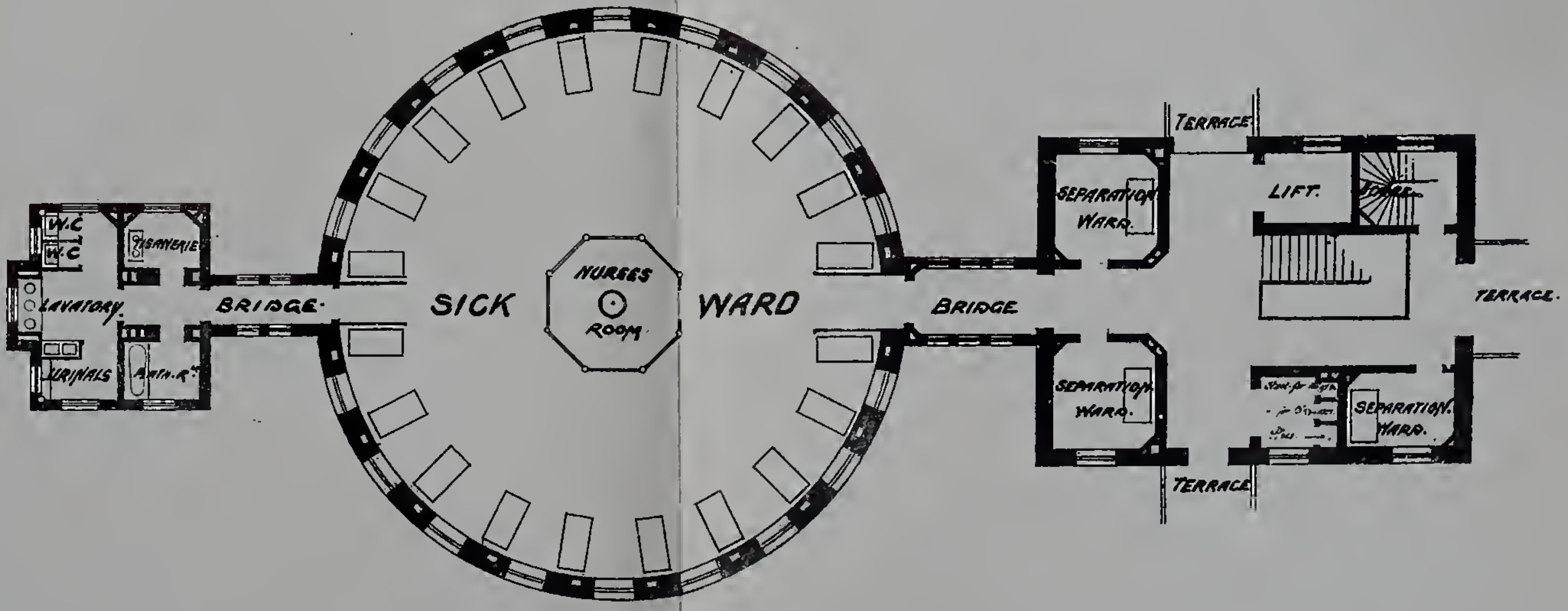




SICK WARDS TWO STORIES IN HEIGHT

Scale feet to Ward Plan.

exceptionally good,—cross ventilated by the passage leading to the towers at the angles. Altogether this is a very satisfactory example.

Antwerp Civil Hospital.

I now come to the consideration of one or two of the most remarkable foreign buildings. The year before last I had occasion to visit Belgium in company with two technical schoolmasters to inspect a series of buildings heated by hot-water upon the high-pressure principle adopted by Messrs. A. J. Bacon & Co., of Antwerp, in different parts of the kingdom, notably the hospital at Ath.

On my return to Antwerp I stayed to inspect the new hospital there, which greatly impressed me. I had seen Mr. Snell's design for a workhouse infirmary upon the system of circular wards, as suggested by Professor Marshall, and given in his work on charitable institutions, but the Antwerp Hospital has since been drawn and described in the work which Dr. Mouat and Mr. Snell have recently published,—to which work I shall also be obliged to refer for the plans and description of the now famons German hospitals which I was unable to see on my tour in Germany last January twelvemonth, being entirely absorbed in the inspection of the Great Polytechnic and Science and Art Schools of that country and Austria, Bavaria, and Switzerland, in company with Professors Armstrong and Ayrton, of the City and Guilds Institute for the Advancement of Technical Education.

M. Baeckelmans was the original designer, but the acting architects are MM. Belmeyer & Van Kiel. The hospital is an irregular parallelogram in form, with canted ends, and the separate blocks are united by the connecting corridors, 10 ft. wide, and one story in height.

The circular wards are external to the said corridors, and the administrative offices are within the same, except the blocks at the two ends.

At the southern end is the main entrance;

the offices and residences of the chief officers, midway between which and the first pair of circular wards is the operation-room on the west side, and the mortuary on the east side of the connecting corridor. In the space between the first pair of circular wards is the chapel.

In the centre of the building, between the next pair of wards and their offices, is the kitchen, dispensary, and officers' dormitories. In the space between the third pair of circular wards are the nurses' apartments and dining-rooms. Between the last pair of wards are the baths, and beyond all, at the extreme northern end, is the detached laundry. The site is entirely surrounded by public roads, and comprises nearly 10 acres, and the cost will be about 360*l.* per bed. There are 380 beds. There is a basement about 8 ft. high throughout, and except for heating apparatus, and fuel, and for ventilating purposes, it is not as yet appropriated.

The sick wards, circular on plan, are 61 ft. 6 in. in diameter, with an average height of 17 ft. The total floor-space is 149 ft. superficial per bed, and the cubic contents 2,525 ft., including the nurses' room in the centre, formed by low partitions between the circle of supporting columns.

The average lineal wall-space, or rather space at the foot of the beds, is about 7 ft. per bed. The area of light is 28 ft. per bed from the eighteen windows. There are two stories of wards only, and the system of heating and ventilation will alone cost 12,000*l.* The fresh air will be passed over coils of hot-water pipes contained in a chamber situated in the basement under the central portion of each tier of wards ; and the air so heated will be forced in by fans, turned by machinery fixed in the laundry building, through the upper parts of the central columns. The removal of the foul air is through the 10 in. by 8 in. gratings near the floor, between each window and each pair of beds, communicating with descending flues and horizontal channels to a central chamber heated by hot-water pipes, from the top of which is carried (right through the centre of the wards) a large iron shaft terminating above the apex of the conical roofs. Thus the fresh air is pushed in by fans, warm or cold as may be desired, at the level of the caps of the columns, and is drawn out by the aspirated central flue through each of the gratings near the floor beneath the heads of the beds. Consequently the ventilation is not dependent on the weather, but can be maintained in all weathers, and the collective areas of inlets and outlets, and the flues connecting the same, are carefully calculated and made of sufficient size to change the air of the ward about three times in the hour without draught, so that it has not time to get foul.

The sanitary offices are a model of good arrangements rarely found abroad; they are entered by cross-ventilated corridors, 12 ft. long and 4 ft. 3 in. wide. They are half the height of the wards, and the space between is left open for the free passage of air. All these offices are specially warmed and ventilated, and they consist here of a duty-room, a bath-room, water-closet, urinals, and lavatories.

The three separation wards for single beds, and the lift and staircases, are situated at the entrance of the wards, but are separated therefrom by a cross-ventilated corridor or bridge.

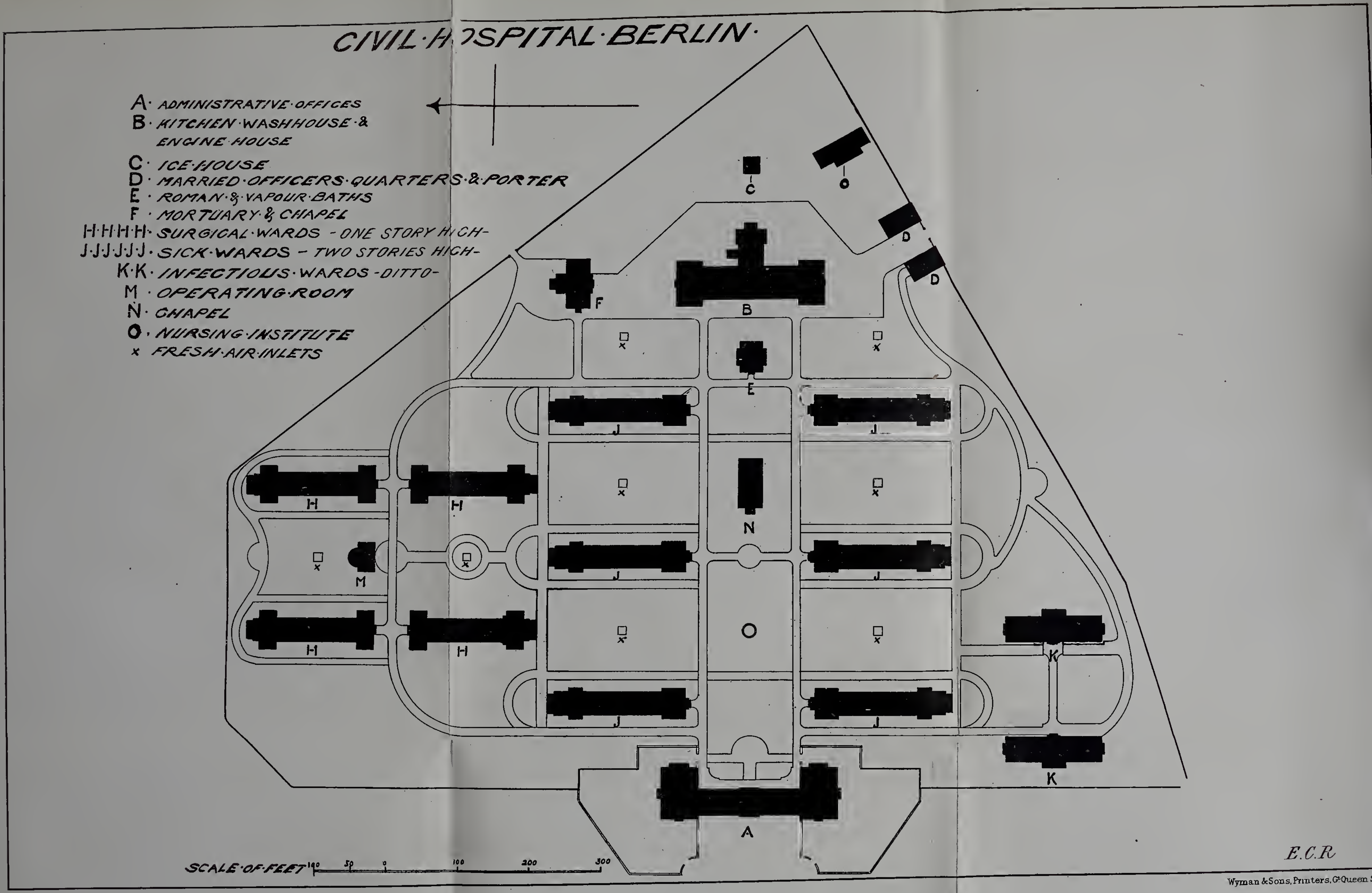
The Hospital of St. Eloi, Montpelier, France.

From Belgium it is an easy transition to France, and the instance I select is one that illustrates the most advanced phase of French hospital building introduced by M. Tollet. Dr. Mouat has thus distinguished it :—" M. Tollet's system may be briefly described to be based on the sub-division of the sick into small and manageable numbers, lodged in single-storied buildings, distributed over a sufficient area to prevent undue pressure upon space, and yet so connected as to be facile of access and administration. His wards are built upon the plan of the Gothic arch, to avoid all stagnation of air or arrest of organic or other matters floating in it by angles or corners of any kind; are intended to be easy of heating and ventilating in winter and summer, without the adoption of expensive mechanical contrivance; to admit of the provision of ample superficial and cubical space for each patient; to be constructed of materials capable of the most perfect cleansing, and to be as nearly as possible fireproof; to be provided with verandahs, to which the beds can be transferred, with little or no disturbance of the sick, in fine weather; and to have the accessories of baths, water-closets, and dependencies of all kinds so completely cut off as to be unable at any time to impair the purity of the atmosphere of the sick-room."

This hospital is divided into three distinct and quite independent portions. The first is the main building, which occupies the great central oval, and consists of eighteen single-story sick-wards, projected from the sides of the open connecting corridors surrounding a central court within, and at the entrance end of which are the administrative departments, chapel, &c.; also receiving-wards, and officers' and nurses' apartments, &c.

The second is the contagious diseases department, placed at the northern and eastern corners of the site, and enclosed by a belt of trees; the disinfection-rooms, the mortuary, and post-mortem room are to the north. The third is the maternity department, on the southern side, in two distinct buildings, surrounded by trees.

On this plan, M. Tollet has already built a large military hospital at Bourges, consisting of twelve pavilions, and the success has been complete. Dr. Mouat is of opinion that M. Tollet's system fulfils all the conditions of salubrity required in hospitals, more completely than any other form of structure with which he is acquainted; but the natural system of warming has been found deficient in winter.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A· ADMINISTRATIVE·OFFICES
B· KITCHEN·WASHHOUSE·& ENGINE·HOUSE
C· ICE·HOUSE
D· MARRIED·OFFICERS·QUARTERS·&·PORTER
E· ROMAN·&·VAPOUR·BATHS
F· MORTUARY·&·CHAPEL
H·H·H·H·H· SURGICAL·WARDS - ONE STORY HIGH-
J·J·J·J·J·J· SICK·WARDS - TWO STORIES HIGH-
K·K· INFECTIOUS·WARDS -DITTO-
M· OPERATING·ROOM
N· CHAPEL
O· NURSING·INSTITUTE
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The General Hospital of Friedrichshain at Berlin

is one of the best of the many admirable examples in Germany of hospital construction, and will be all-sufficient to indicate the advances made in the adaptation of the pavilion system. The military hospitals at Berlin, Düsseldorf, Königsberg, Custrin, &c.; the University hospital at Heidelberg, described by Mr. Gordon Smith; and the Dresden public hospital, are all excellent examples.

The civil hospital of Friedrichshain was completed in 1874, and took six years in building. It was the result of much study, in which all the most eminent German authorities took part, and it has issued in the production of a building which, as Mr. Snell observes, "may be said to mark an important era in the science of hospital construction," adding "the introduction of one-storied pavilions, although limited to the surgical division only, is especially commendable, as being the possible forerunner of a total abandonment of the principle of erecting hospitals, two, three, or more stories in height. The French have already commenced the erection of hospitals, the sick-wards of which are all of them but one story in height, and there can be little doubt that the universal adoption of this principle is but a question of time."

In the general arrangement of the site, the administrative offices are in front, towards the west, and at the extreme east is the kitchen, wash-house, and engine-house block, of three stories above the basement, between which are the chapel and the Roman and vapour baths, both within the central court, 700 ft. by 150 ft. wide, formed by the open paths at first intended to be covered ways, connecting the administrative offices and the kitchen block with the entrance ends of six sick-wards, situated equidistant from each other with their axes due north and south, or exactly opposite to those of Heidelberg, the axes of which are due east and west. I think the former arrangement the right one. The distance between them is seven times their height. The mortuary is to the north of the kitchen and laundry block. These general sick-wards are in two stories above the basement. So also are the two infectious wards at the south-west of the site.

On the north side of the general hospital are the four single-storied surgical wards, with an operating-room between the northernmost of the wards.

This is a pavilion hospital pure and simple, without even the usual connecting corridor either open or closed, but simply paved pathways, with the surgical wards of one story only, and no sick-wards more than two stories in height. What Miss Nightingale said of the Lariboisière sick wards, that "they were as distinct from each other as if miles apart," is much more applicable to these buildings. Separate buildings are provided for the ice-house, married officers' quarters, and nurses' institute.

The total accommodation is for 600 beds,—16 wards for 28 beds each, eight for 8 each, 32 for 2 each, and 24 for 1 patient in each, and the cost was 350*l*. per bed. The large wards for 28 beds are 97 ft. long, 29 ft. 9 in. wide, and 14 ft. 6 in. high, or about 107 superficial feet per bed, with cubical contents of 2,076 ft. per bed, the lineal wall-space per bed being 6 ft. 11 in. The area of light is about 24 ft. per bed, with double sashes. The wards are paved with tiles, and the walls plastered and painted. The sanitary offices are well fitted with English apparatus, but there are no cross-ventilated lobbies, nor anything to prevent the air of these places contaminating the air of the ward, except the general ventilation, which has been carefully thought out.

The advantages and disadvantages of heating by hot air or by hot water were elaborately discussed, and specially reported and experimented on, with the result that all the buildings, except the infectious block, should be heated by hot-water circulation. But an open fire is placed at the end of each ward, and in the day-room beyond, from which entrance is obtained to the verandah, into which patients can be wheeled in fine weather. The fresh air is passed into the ward over the warmed pipes, about 6 ft. from the floor, through the three pedestals enclosing the coils, and passes upwards, and returns to the exhaust gratings situated near the floor, which communicate by flues with the iron flue in the great chimney-shaft, at the base of which a fire is going at all seasons, by which means the air in the brick shaft enclosing the iron smoke-flue is carried forwards and upwards by rarefaction, on the principle described by Professor Tyndall in his speech at the opening of this institution by the Duke of Albany.

Besides the two single separation wards, the single-storied surgical wards have an operating-room. The medical wards have two separation wards of two beds each. Between these wards and the nurses' room and duty-room, which latter overlooks the great ward, there is a cross-ventilated passage. If a similar cross ventilated passage had been added to the conveniences and lavatories by increasing their lateral projection, these wards would have been perfect. I think, if nurses were polled, they would give the preference to narrower windows and a single bed between each window, instead of the usual number of two.

I have little to add to what has now been advanced, but sufficient has been said to show how much has already been done towards the solution of the great problem with which we set out, viz., How can great hospitals, with hundreds of sick congregated within their walls, be kept going with as healthy surroundings as a private residence in the country? and I think we may conclude that few such dwellings could compare with the wards of the great Civil Hospital at Berlin.

I have said little of the defects of the older hospitals. I must refer you to Miss Nightingale's "Notes" for these criticisms,—valuable as warnings,—and will be content to quote one passage, which, by its great contrast with our present practice, will at least show the advances made in the last century.

Miss Nightingale observes,—"By far the most remarkable illustration of the effects produced on the sick and maimed by agglomeration is that afforded by the experience of the Hôtel Dieu at the latter end of the last century, and before its reconstruction after the fire, on the plan which I exhibit, and which cost nearly a million and a half of money. There was direct atmospheric communication through the entire suite of wards, occupied by above 550 beds on a single floor. The whole hospital contained 1,200 beds, but the beds by no means represented the number of sick, who were sometimes placed together in the beds as close as they could lie. And in this way, from 2,000 to 5,000, or even 7,000, sick were sometimes in the hospital at one time, and *one out of every four patients used to die.* So late as the year 1788, *each of the beds* in the Hôtel Dieu was intended to hold either two or four sick."

M. Husson, in his book entitled "Étude sur les Hôpitaux," shows that in the sixteenth century, and notwithstanding the use of multiple beds, holding, in 1515, from eight to twelve patients in each, the number of sick in the Hôtel Dieu so far exceeded the bed accommodation that the beds in 1530 were occupied by relays of patients, and forms were provided in which the sick whose turn it was to be out of bed could rest in the meantime. "Say not that the former times were better than these, for thou speakest not wisely concerning this thing." But I think we shall all agree with Miss Nightingale that the subject is almost too painful to dwell on, especially as we must take it for granted that the administration of the period acted according to the best of their judgment. Only let us not reproduce, even on a small scale, the same structural defects or mismanagement which led to such terrible loss of life. We may, at least, congratulate ourselves that every patient has long since acquired the right to his own separate bed,—a right, however, which has not yet been fully extended to schools, but is rapidly being so, and in the form of separate cubicles in the one large dormitory.

I have no time to describe details of construction, but this museum contains sanitary materials and appliances and working models of ward windows and hospital apparatus generally, in great plenty, and well worthy of careful study.

DISCUSSION.

The Chairman (Dr. F. J. Mouat, of the Local Government Board) said that before proposing a well-earned vote of thanks to Mr. Robins for his admirable paper, he hoped the meeting would be favoured with observations from some of the audience, amongst whom he saw several gentlemen who were well qualified to speak on the subject.

Dr. G. V. Poore said he desired to make a few remarks upon Mr. Robins's very excellent paper, which seemed to be a most valuable one, inasmuch as it showed how an architect was impressed with the fact that the building of a hospital was a very grave responsibility, and that if the plan of a hospital was not thoroughly well considered, what was meant for a blessing might turn out to be a curse. Now, there were certain things insisted upon by the constructors of modern hospitals as to the necessity of which he (the speaker) was to a great extent a disbeliever. Mr. Robins had described the Friedrichshain Hospital at Berlin as a one-storied pavilion hospital, but it was perfectly certain that in a great city like London, where land was sold by the square inch, one-storied pavilion hospitals were out of the question. Nor did he think that they were necessary. Certainly they presented great inconveniences, for the enormous areas which they occupied (where they were of any size) greatly increased the trouble and difficulty of administration. Take, for instance, the Johns Hopkins Hospital at Baltimore, which was built to accommodate 400 patients, but which occupied a site of about the same area as the Horticultural Gardens at Kensington. A patient lying (say) at the Albert Hall, and for whom a chop had been ordered, would have to wait for it until it could be brought (say) from the South Kensington Railway Station. It was all very well to say that in hospitals covering such large tracts of ground tramways, speaking tubes, electric bells, and all other appliances for saving time and labour, were introduced; such appliances were apt to get out of order, and that, very often, at most critical and inconvenient times. For this and other reasons, then, he was perhaps somewhat heretical in some of his opinions as to modern hospital planning. He did not speak without having given some attention to the subject, for he had made a plan for the re-building of University College Hospital on its present site which had met with Mr. Waterhouse's approval. That plan was to be seen in the Museum. In that plan he had endeavoured to carry out what was, he felt sure, a very great and important principle in hospital planning, viz., that it should not be possible in a hospital for any person to pass from one ward to another, or from one story to another, without going into what was, practically, the open air. In other words, he would make the staircases and corridors of communication open to the air on each side. A hospital should not be considered as one large house, but rather as a series of houses, which the doctor should visit in turn just as he would go from house to house in a village, passing into the open air in going from one to another, and being clothed for out-door walking according to the weather. The great defect in many of the costliest of the pavilion hospitals was that the staircases were in the pavilions themselves. That was a vital error. Where the staircases were *in* the pavilions it was quite possible for a disease germ to pass up or down the staircase and along the corridor from one ward to another. But not only were staircases placed in the heels of the pavilions, but lifts going from floor to floor were sometimes placed there, with what probable result in case of infectious disease medical men would know. When he went over a large pavilion hospital some time ago, in company with one of the medical men connected with the institution, he put his head inside the shaft of one of the lifts which were to be found there. His friend quickly and energetically warned him against what he was doing by calling out: "Take care! Take care! There is a case of scarlet fever upstairs!" That showed what his friend thought of the arrangement. A great evil in many modern hospitals was that very much money was spent, and a great deal of space was given, where both money and space might be saved. Because ample cubic capacity and floor space were essentials (though within well-defined limits) in the wards themselves, it was not therefore necessary to have every little office and adjunct planned on the scale of a palace. Some people had held up the Hospital Ménilmontant as an example for imitation. There the patients looked out of their wards on to 15 acres of garden ground. Much good might it do them! It should be remembered that fresh air, to do the patients in a hospital any good, must be on the *inside* of the panes of glass. In the same hospital the corridors and staircases were needlessly wide and too numerous. In the new Infirmary at Edinburgh, too, the width of the staircases and corridors was somewhat excessive. Another point to which he wished to call attention was that in many modern hospitals the ward kitchens, water-closets, and other offices were a great deal too large. Ward-kitchens were sometimes made ridiculously large,—big enough to roast a baron of beef. What was wanted was merely convenience for making such things as a little beef-tea or for cooking a chop, and in these days a gas-jet would answer all purposes. The water-closets at St. Thomas's Hospital were enormously big. It should be remembered that there was a limit to the advantages of spaciousness, for where height and area were in excess not only was the initial cost of the building increased, but the cost of maintenance and the difficulty of ventilation were increased also. In his (the speaker's) plan for the reconstruction of University College Hospital, the kitchen, the dead-house, the *post-mortem* and lecturing rooms, and, in short, everything that was likely to smell, was placed on the top story of the building. That had not been done anywhere else, he believed. [The Chairman: It has been done in America.] At any rate, it had not been done anywhere in this country. He understood that at Owen's College, Manchester, the dissecting-room was on the top story, and that the arrangement was very satisfactory.. Obviously that was the proper situation for such places, for at the top of a building there was a great deal more light and air than could be obtained down-stairs. As to ventilation, he thought there was no doubt that in this country, where the climate was mild, natural ventilation was the best. Where there was an elaborate system of ventilation by flues, who was to see that the flues were kept clean? He believed that at the Johns Hopkins Hospital at Baltimore there were many miles of ventilating pipes, while in the new Infirmary at Edinburgh there was a long extent of extracting pipes. The action of these extracting-shafts was, no doubt, perfect in theory, but did any one ever know a chimney that did not smoke at times? Was it not possible that these extracting-shafts would sometimes be found acting as inlets? Aware of the nature of the matter that collected in such extracting-shafts, he should not like to be lying in a bed near such a shaft when it began to "smoke,"—*i.e.*, to serve as an inlet.

Dr. Steele said he felt very diffident in saying anything on the subject, seeing what had been done and said by the chairman, Captain Galton, and Mr. Robins; but he was afraid he must confess himself, with Dr. Poore, the holder of somewhat heretical opinions as to hospital construction. His experience disposed him to stand up in defence of the old-fashioned quadrangular planning of hospital buildings, as against the pavilion system, which was an importation from abroad, having been in existence in Paris, Brussels, and other Continental cities, long before it was introduced into this country. In his opinion the quadrangular form of plan for hospital buildings made the administration much easier; it facilitated ventilation, afforded pleasanter outlooks to the patients, and it was better adapted to clinical and scholastic purposes than the pavilion style of building. He did not object to the pavilion ward as a ward, but he objected to taking a number of those wards and arranging them side by side on the pavilion principle. In the case of the Herbert Hospital the blocks of wards were about 100 ft. distant from each other, and were connected by corridors; being three-storied buildings, the spaces between them must be, to a certain extent, filled with stagnant air. What arrangement could be more miserable for the patients than the pavilion principle of planning, whereby the patients in one block could only look out towards the patients in another block? Again, in a large hospital planned on the pavilion principle the distance from one extremity of the building to another was often excessive; in the case of St. Thomas's Hospital it amounted to a quarter of a mile or more. How, under such a condition, was it possible for any one person to exercise any proper supervision over the building? For these reasons he was in favour of the quadrangular form of planning for hospitals, the buildings being arranged somewhat in the form of the colleges of Oxford and Cambridge, or, more nearly, in the form adopted at St. Bartholomow's Hospital, in the City of London. The blocks of this hospital were arranged on the four sides of a quadrangle, but were disconnected at the angles, leaving plenty of space for the circulation of air all round each block. In his experience there was no hospital better adapted for clinical or scholastic purposes, or more easy of supervision, than St. Bartholomew's. Although, as he had said, he had no objection to a pavilion ward as a hospital ward, it was very difficult in crowded towns and cities to obtain adequate space for the arrangement of a number of wards on what was known as the pavilion system of planning. As regarded private or civil hospitals, supported to a large extent by voluntary contributions, the cost of land would often be a bar to the adoption of the pavilion system at the outset; while as to Government and parochial hospitals, their cost would be unduly augmented. To take the case of a voluntary hospital about to be established in some locality where its need had been felt. The committee looked out for a site; very likely that site would be covered with house-property of a poor character, and in a very thickly-populated locality,—for it was of no use to build hospitals except in the midst of the people for whose benefit they were intended. The site having been cleared, upon a portion of it a building was put up to contain fifty or 100 beds, and possibly the building would be rectilinear in form, and three or four stories high. In the course of a few years the growth of the community and an increase of means might render an enlargement of the institution not only desirable, but necessary; such enlargement could then be effected by building another block either facing the first block, on the opposite side of the site, or at right angles to it. Successive enlargements might follow, each one taking the shape of a separate block, until the quadrangle was enclosed on all sides, the corners, however, being left free, as at St. Bartholomew's. It was too often the case that when hospitals planned on the rectilinear system had to be enlarged, such enlargement could only be effected by putting on cross pieces either at the ends or the centre of the building, making it take the shape of the letter T or H. Such a method of enlargement was objectionable, as tending to agglomeration, and thereby rendering the buildings unfitted for their purpose. He quite agreed with Dr. Poore in saying that it was useless to attempt to build hospitals of a single story in this country, owing to the density of the population. He did not think that the pavilion system with ward blocks three or four stories high was the most economical, convenient, or efficient form of planning for hospitals, but would prefer to see detached blocks, arranged as at St. Bartholomew's, enclosing a space of about one acre in extent. As to the rate of provision of cubic space per patient, he thought that existing rules needed some modification in view of the fact that within the last fifteen or twenty years the antiseptic method of dressing wounds had come into general use, and hence the air of hospital wards was saved from contamination to an extent that would not have been possible before antiseptic dressings were in use. The air of modern hospital wards had thus every chance of being healthier and purer than formerly, and whereas it was the custom to allow from 1,500 to 2,000 cubic feet of space to each bed under the old non-antiseptic treatment of wounds, it was his opinion that with the general use of the antiseptic dressings from 1,000 to 1,200 cubic feet per head would be quite sufficient to allow in general hospitals, having due regard to the desirability of curing each patient as speedily as possible.

Professor Corfield said he would not attempt to add anything to what Mr. Robins had said as to the construction and planning of hospitals, as his remarks on that head had been so ample, and had been criticised by the previous speakers. But Mr. Robins had incidentally referred to the evils of the practice (once very common) of massing together patients suffering from all sorts of diseases in general hospitals, and to the overcrowding of wards. The disastrously high death-rate resulting from these practices at the old Hôtel Dieu in Paris was a lesson never to be forgotten by those who had the designing and management of hospitals committed to them. Mr. Robins, so far from over-estimating the evils of such malpractices, had under-estimated them. The practice of placing cases of infectious diseases, such as small-pox, scarlet fever, measles, and other communicable diseases, in the general wards of a hospital, could not be too strongly deprecated, and there was still, he was sorry to say, necessity for deprecation on that head. In his experience he had seen communicable diseases pass round a hospital ward just as the surgeon would pass round, occasionally missing-out a bed here and there, just as the surgeon would, because the patient was too well to be noticed. Not very many years ago he had considerable difficulty in preventing the introduction of scarlet fever patients into the wards of a general hospital in London; and it was still the practice in most of the London hospitals to introduce infectious cases into the general wards: he referred to cases of typhoid fever, which, there could be no question, was a communicable disease, and which he had no doubt he had seen communicated within the wards of a hospital.

Dr. Dawson Williams said it was not necessary to go so far as Manchester in order to find an instance of the placing of a mortuary on the top of a hospital, as that had been done at the new Medical Schools of the Charing-cross Hospital, which, although a separate building, really formed a part of the hospital, as connexion between the buildings was effected by means of a tunnel beneath the intervening roadway. With regard to ventilating appliances, he might say that when he was clinical assistant in the Hospital for Consumption at Brompton, a committee was appointed to examine into the ventilation of the building (the older one), partly because the wards were very stuffy, and partly because they were going to erect the new building. In examining the interior of the extracting-shafts, the committee found an extraordinary deposit of material, which was of the nature of a fine reddish woolly powder. Another thing the committee found out was that there was a tremendous current outward from the main extraction shaft, which was heated by a steam coil, although the majority of the extraction openings in the wards were either useless, or were acting as inlets. The whole system of ventilation was apparently reversed in its action. It was subsequently discovered that the majority of these ward extraction-shafts, which were very high, all leaked, so that the only result of the hot coil in the main extraction-shaft was to ventilate the spaces under the roof, which were not used. He went about a good deal amongst the hospitals of London, but he had no means of making a comparison as to the death-rate of hospitals planned on different methods. The surgeons at St. Bartholomew's, however, expressed themselves in the most favourable terms as to the healthiness of that hospital, which consisted, as had been stated, of four large detached blocks arranged on the sides of a quadrangle. One of these blocks was mainly, if not exclusively, devoted to administrative purposes, but the mortuary, dissecting-room, museum, &c., were entirely separated from the main blocks. After what Dr. Steele had said, and in view of the opinion of the medical men at St. Bartholomew's, he should like to know whether there was any authoritative objection to the disposition of what was essentially a pavilion hospital in a quadrangular form. Dr. Poore had remarked that it was an absolute necessity that modern hospitals should be built three or four stories in height. No doubt that necessity was imperative, assuming that our large hospitals must be built on town sites, but he was in favour of doing for the London hospitals what had been done for Manchester in the case of the Children's Hospital at Pondlebury. The main hospital was three or four miles from the centre of the city, in which there was a small central depôt for urgent cases and for cases which could not be safely transported a few miles. If our great London hospitals were taken to such localities as Hampstead or the Surrey Hills, leaving only comparatively small emergency hospitals in town for accidents and urgent cases, the results would be, he believed, in every way beneficial.

Mr. William White said that, as an architect, he desired to express his personal appreciation of the exhaustive manner in which Mr. Robins had treated his subject, his paper embodying apparently all the salient facts regarding a large number of the most modern hospitals. As Dr. Poore had said, the architect felt, and could not help feeling, a deep sense of his responsibility for the arrangements of a hospital which he might be called upon to plan; but he (Mr. White) maintained that that responsibility should not rest exclusively, or even chiefly, upon the architect, who should be able to look to the members of the medical profession for an authoritative declaration as to the requirements of a hospital. But the architect should be expected to plan and construct a hospital capable of meeting the requirements deemed necessary by the medical profession. The principles which could be most advantageously adopted in the planning of a hospital could only be laid down by medical men, and by them only after a long and tedious process of inspection and analysis of the working and results of different methods of arrangement. He was very strongly disposed to acquiesce in what Dr. Steele had said as to the needless waste involved in making the wards and offices of a hospital too large, for, of course, the larger a building, the greater the cost of its construction and maintenance, the greater the labour of administration, and the more difficult the ventilation.

The Chairman, in closing the discussion, said that great as was the amount of gratitude due to royal commissions, to Miss Nightingale, to Mr. Godwin, and othors who had of late years thrown light upon the true principles to be observed in hospital construction, it should not be forgotten that every important change which had been effected was first advocated by M. Tenon, the Paris physician, who pointed out the extraordinary and awful circumstances of the old Hôtel Dieu, and whose work, although written close upon a hundred years ago, was still, in many respects, the very best book which had been written upon the subject of hospitals. Within the last few weeks he had had an opportunity of seeing, in company with Mr. Saxon Snell, the magnificent hospital near Berlin to which Mr. Robins had referred, and he had no hesitation in saying that if those gentlemen who owned to holding heretical views on the subject saw the building for themselves they would speedily discard their heresy. Nothing more perfect or more admirable could be conceived. He quite agreed with Dr. Poore and Dr. Steele in saying that the hospitals must be placed in the midst of the poor. The best town hospital he had ever seen was the New York Hospital, which was six stories in height, the kitchen, laundry, mortuary, and other places likely to cause unpleasant odours being placed on the top stories of the building. That hospital was provided with a pleasant winter garden for the use of the patients, and the perfect ventilation which existed throughout the building showed that all difficulties of site might be, by proper structural arrangement, perfectly overcome. Notwithstanding what had been said in the course of the discussion, he still held it as a cardinal doctrine that the pavilion system of planning, as usually understood, was the best for large modern hospitals. M. Tollet's system of planning went even beyond that, and with results as yet unapproached in this country. The other day, being in Paris, he visited a hospital erected by M. Tollet on one of the bastions. It was located in a manufacturing quarter of the city, and was, therefore, much in request in cases of accident. In spite of the fact that the Assistance Publique had done its best to handicap the successful working of the hospital by overcrowding it, and by diverting some portions of it to other uses, the patients got well more rapidly than similar cases could be cured in the older hospitals, and they were enthusiastic in their appreciation of the building. He had also visited the military hospital at Bourges, constructed on M. Tollet's system, although even here the architect's views were not fully carried out, the military engineers having changed some parts of the buildings in execution. Now, although there were at Bourges extensive artillery foundries, in the carrying on of which the workmen often received very bad injuries, and although the hospital had been opened four years, there had not up to the present time been any pyæmia, or other bad results. The officers of the garrison spoke against the hospital (while admitting that the patients got well) for no other reason, it was said, than that, being three miles away from the town, its supervision by them somewhat interfered with their recreations. As to the difficulties of artificial ventilation, he was well aware of them. On a certain occasion it was his duty to inspect a Poor-law school, where he found, in one great room or dormitory, 174 children sleeping, many of them two-in-a-bed. The atmosphere was insufferably impure. In this school there was a great prevalence of eye and skin diseases, and no wonder, for all the windows of the dormitory were hermetically closed, and not made to open freely, the means of ventilation relied on being a large central shaft. This not seeming to act at all, it was examined, and was found to be blocked up, and further inquiry showed that it had been so blocked up for five-and-twenty years, and nobody knew it! Did time permit, he could recount many more incidents of a similar kind which had come under his personal observation in the course of his official duties. In conclusion, he begged to propose to the meeting a very hearty vote of thanks to Mr. Robins for his excellent and instructive paper.

The motion having been carried by acclamation,

Mr. Robins briefly replied, expressing regret that he had not included amongst the plans referred to the one proposed by Dr. Poore for the reconstruction of University College Hospital. He thought that Dr. Poore had given some conclusive evidence in favour of hospitals of one or two stories only. Berlin Hospital was a two-story building, the surgical wards alone being one story. If, as he suggests, a chop could be cooked in a ward kitchen, it certainly need not be taken from Dan to Beersheba to arrive at the patient in waiting. In many pavilion hospitals, as at Blackburn and Antwerp, the staircases did not form part of the ward block. At Antwerp they were cut off by a cross-ventilated passage, twice its width in length. Dr. Steele's advocacy of the quadrangular form with corners open, was only another form of the pavilion principle, of which the hospital at Vincennes was an example. His valuable suggestion that the antiseptic dressing arrangements now in vogue reduced the necessary cubic space per patient to 1,000 ft. or 1,200 ft., should not be forgotten in planning new hospitals. Dr. Corfield had touched upon a serious defect of hospital management, and he might have gone on to show that the carelessness of doctors and the freedom given to visitors of the sick was a fruitful cause of the distribution of disease. Dr. Williams had made an important suggestion when he proposed the erection of small town hospitals for accident cases and large suburban general hospitals. But if he thought that ventilating arrangements could go on automatically without the constant attention which every other sanitary appliance received, he was much mistaken. Mr. White had shown that architects could carry out the principles laid down by the doctors, but it remained with the doctors to see that the appliances needed to carry out their principles were kept in working order. The evil was that nobody considered himself responsible for this, and consequently the most ingenious arrangements were rendered futile.

On the motion of Mr. Rogers Field, a vote of thanks was given to the chairman, and the proceedings terminated.

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